A LOW TEMPERATURE MEASURING RESONATOR FOR EPR STUDIES AT 0·8 cm WAVELENGTH

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THE accuracy of measurement of EPR spectra for single crystals depends on the accuracy of the determination of orientation of the crystal axes in the external magnetic field and on the accuracy of measurement of the induction of the d.c. magnetic field in the region of the specimen. (It is assumed that the frequency of the a.c. electromagnetic field and the temperature of the crystal are constant during the time of a measurement and are known with sufficient accuracy.) In the construction of a measuring resonator there must therefore be the possibility of, firstly, orienting the crystal studied in two mutually perpendicular planes during the measurement and, secondly, placing an NMR probe for measuring the magnetic field induction in the immediate neighbourhood of the specimen being studied. Usually either the magnet is rotated round the resonator containing the specimen to orient the crystal in the horizontal plane (through φ) or the specimen is rotated inside the resonator. Only the latter possibility remains for rotating the specimen in a vertical plane (through θ)—the crystal is turned inside the resonant cavity. Since one cannot avoid rotating the specimen in the resonator in order to produce any required crystal orientation, we fixed on a resonator construction which does not demand rotation of the electromagnet. In similar constructions for 3 cm and greater wavelengths, it is usual to employ a shaft of a material with poor thermal conductivity for rotating the specimen through ϕ, and this passes through a thin walled tube of similar material and lies along the vertical resonator axis,[2,3] and the specimen is fixed on the end of the shaft and can be extracted from the resonator.

In the resonator construction described (Figure 1), the rotating piston 1 is used, and to avoid detuning of the resonator on rotating the piston, by the misalignment, two stiff bellows 3 and 4 made on a lathe from phosphor bronze are mounted in tube 2. By using a piston which can be withdrawn easily, a large crystal, dependent on the size of the resonant cavity, can be fixed on it. The resonator itself 5, is made of seamless calibrated copper tubing of internal diameter 12 mm and wall thickness 1 mm. Over the whole

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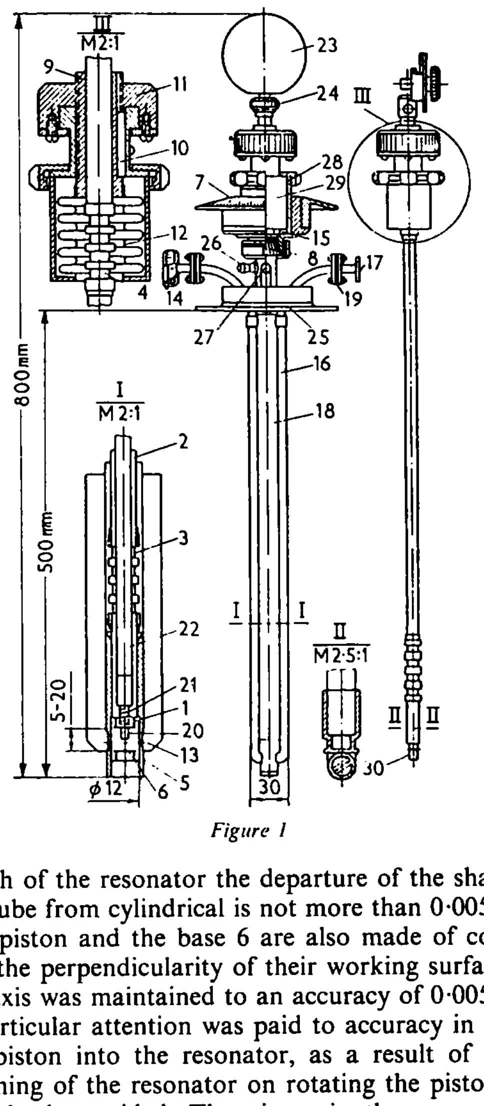

Figure 1

length of the resonator the departure of the shape of the tube from cylindrical is not more than 0·005 mm. The piston and the base 6 are also made of copper, and the perpendicularity of their working surfaces to the axis was maintained to an accuracy of 0·005 mm.

Particular attention was paid to accuracy in fitting the piston into the resonator, as a result of which detuning of the resonator on rotating the piston was completely avoided. The piston in the resonator is tuned by tube 2, connected to dial 7 which has a 360 degrees scale on which the angle of rotation ϕ of the piston is read.

A vacuum conical coupling 8 is used to preserve the vacuum as the piston is rotated. The piston can be moved forward for tuning the resonator by a micrometer guide screw 9 which travels along the key-way